
Cluster Strategies for Washington

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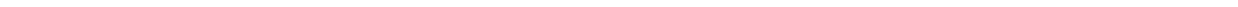


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Executive Summary

This report is based on the central hypothesis that the economic success of regions depends on the competitiveness of key industry clusters in each region. A cluster consists of lead or final product industry and this industry's suppliers, often concentrated in a particular sub-state region. Individual companies succeed or fail not just due to their own efforts, but in part because of the success of the cluster in the region due to inter-firm networks and multiplier effects. By becoming aware of cluster characteristics and key challenges and opportunities facing regional clusters, economic and workforce development agencies can do a better job of providing services that enhance regional competitiveness.

Six clusters were chosen for detailed investigations in Washington State based on the relative density of cluster firms in a region of the state as compared to the nation. The clusters chosen for study include:

Cluster	Region (and City)
Agriculture/Food Processing	Southeast (Kennewick)
Forest Products	Olympic Peninsula (Port Angeles)
Semiconductors	Southwest (Vancouver)
Measuring Devices & Instruments	Puget Sound (Everett)
Biotechnology	Puget Sound (Bothell)
Health Care	Northeast (Spokane)

While a number of other clusters such as international trade, aerospace, aluminum, software/Internet, and tourism are also significant in portions of the state, prior work on some of these other clusters by the State or other organizations resulted in a decision to focus on the first six. The goal is to demonstrate the utility of thinking about economic vitality issues in a cluster framework, not to provide a definitive report on all important clusters in this state. If the cluster framework proves useful to state and local policymakers, then studies of conditions in additional clusters may be an important next step.

For each of the selected clusters, employment and revenue data were assembled to get a sense of trends in the last decade, and lists of significant institutions supporting each cluster were assembled (education, research, and industry organizations). Focus group discussions were held with representatives of the cluster including both private firms and significant institutions. Based on this information, recommendations specific to each cluster were prepared for state agencies, and a more general set of recommendations regarding cluster based strategies is offered at the end of the report. The major findings and recommendations are summarized in the next two pages.

Agriculture/Food Processing

The Agriculture and Food Processing cluster earns \$7.5 billion in gross revenues annually, employing nearly 50,000 workers. This state has a rich endowment of land and water resources

to support a diverse agricultural sector with major products including wheat, apples, and a wide variety of other field, dairy, and meat crops.

Foreign competition and increasingly stringent environmental regulation have constrained or in some cases eliminated profitability for many growers and processors. Labor issues are also affecting the profitability of firms in this cluster; concerns include the indexing of the state minimum wage, record-keeping required for the minimum wage in the context of a piece work compensation tradition, housing requirements for migratory workers, alien worker documentation problems, and increasing skill requirements due to technological changes both on the farms and in the processing plants. Energy and water issues have made the situation especially difficult in the last year.

Recommendations for this cluster include:

- Convene state agencies assisting and regulating the agriculture and food processing industries to develop a more unified regulatory strategy.
- Continue to support the wine country tourism initiative.
- Support Washington branding and other efforts to promote Washington grown food products to consumers.

Forest Products

While the Forest Products cluster has contracted in the past decade in response to harvest restrictions, it still produces nearly \$6.4 billion in annual gross revenue and is a significant source of employment in several forested regions of the state. Second and third growth forests are reaching maturity and will produce a “wall of wood” available for harvest in the decades ahead, assuming that the industry can navigate the increasingly complex and stringent regulations that have been enacted to protect streams, forests, and the habitats of various endangered or threatened species.

Some companies in this cluster are exploring the role of environmental management certification as a way of convincing consumers to buy their products. Other cluster members feel that they will be forced to adopt this strategy of industry leaders do so, and would like the state to explore certification of all state-regulated forest lands based on the state’s Forest Practices Act. Other cluster members feel that the public does not understand their current practices or the scientific basis for those practices and suggest steps to improve public awareness of these issues. The cluster is also coping with foreign competition both from Canada and a variety of Pacific Rim countries, and slow market conditions due to Japan’s prolonged slump and slower household formation rates in the United States. Additional challenges are posed by last winter’s energy crisis and the introduction of engineered wood products.

Recommendations for this cluster include:

- Assess the potential role of environmental certification of forest products and evaluate the requirements of the state’s Forest Practices Act (FPA) in relation to several alternative environmental certification standards.

- Improve coordination of state programs that provide technical assistance to forest products companies.

Biotechnology

Biotechnology is a difficult cluster to define since firms identifying with the cluster are classified in several industries, including research laboratories, pharmaceutical product manufacturing, and several other manufacturing sectors providing specialized equipment and instrumentation. Supporting institutions include research institutes and universities, as well as lawyers, accountants, venture capitalists, and other service providers who specialize in serving biotechnology and biomedical product companies. Attempts to define the size of the cluster based on sector employment suggest that about 14,000 workers may be employed in the cluster, nearly a 60 percent increase from 1990. However, the Washington Biotechnology and Biomedical Products Association suggests that its membership list may more accurately characterize the cluster due to the diversity of firms that identify themselves with this cluster.

Firms and institutions in this cluster are relatively young, often supported by venture capital, and staffed by a very high proportion of scientists with advanced degrees. Some companies hope to achieve profitability by eventually manufacturing products while others are pursuing a strategy based on research, garnering revenues from royalty and licensing arrangements, or by seeking equity investments from large pharmaceutical companies.

Major issues raised by representatives of this cluster include support for high quality education emphasizing science and mathematics, research funding from public institutions at the federal and state level, strengthening technology transfer programs at universities and research institutes, access to laboratory space for startup companies, and regional diversification of the industry within the state.

Recommendations for this cluster include:

- Ensure excellence in science and mathematics as an integral part of K-12 education reform.
- Work with research institutions, industry associations, and interested private companies to establish one or more facilities providing wet lab and office space for start-up biotechnology companies.
- Create a more aggressive technology transfer program at the University of Washington.

Electronics: Semiconductors and Measuring Instruments

Following the focus group discussions in these two clusters, we decided to group them together under the heading of “Electronics” based on a prior cluster analysis and similarity in the issues these clusters face. Both of these clusters are producing digital electronic technology products, and both function in a global marketplace. Neither local customers nor local suppliers are sufficient to sustain these clusters; they search the globe for customers and suppliers. They have chosen to locate in Washington for historical reasons that may or may not still apply. While the semiconductor cluster is spilling north from the Portland metropolitan area in Oregon into Clark

and Cowlitz Counties in Washington, discussions with representatives of the cluster suggest a fragility of these siting decisions depending on resolution of energy, water, and labor issues, as well as the availability of incentives to elicit further private investments.

In the measuring instruments cluster in the North Puget Sound, growing technical university programs in Asia are resulting in opportunities to out-source not just production of components but also design and engineering. Wage differentials between China and the United States compel these firms to reconsider the entire basis for their presence in Washington. In addition, traffic congestion issues both of these regions of the state are leading some firms, particularly at relatively remote Puget Sound sites, to rethink their location choices. The quality of life in the state is a major factor supporting these clusters, albeit downgraded by traffic congestion, but historical advantages with respect to electric power costs and water quality and availability combine with international trends to pose serious competitiveness challenges.

Recommendations for this cluster include:

- Establish new degree granting authority for those education institutions that are willing to support local electronics companies in new ways, particularly in advanced engineering fields.
- Re-examine regulatory processes relative to site development and develop a strategy to improve predictability and shorten the time required to reach decisions on environmental and other issues that hold up permitting.

Health Care

Health Care is a massive cluster employing nearly 217,000 workers and producing \$13.2 billion in annual revenues. Washington has several significant regional health care clusters, including the Seattle area, Tacoma, and Spokane. Aging of the population seems to guarantee continued growth of this sector, although there is also significant concern among a wide variety of employers including government agencies about curtailing the increase in health care costs. The tension between demand for health care services and the need to control costs have resulted in several national and state attempts at “health care reform,” but it is safe to predict that these issues will be contentious public policy matters for some time to come.

Reimbursement policies, industry reorganization, nursing and other staff shortages are some of the major challenges facing the cluster. Opportunities for further growth are also present, based on advanced informatics systems, expanded collaboration among health care providers, and linkages between health care and emerging biotechnology and biomedical device companies.

Recommendations for this cluster include:

- Support efforts to promote regional health care clusters such as the one in Spokane.
- Support development of biotech manufacturing and related biotech/biomedical industry segments.

Overall Cluster Based Policy Recommendations

1. Periodically assess development trends and prospects for major regional clusters.
2. Periodically convene cluster roundtables to assess conditions in each cluster, establish public policy and program agendas, and work jointly on implementation.
3. Regularly review state agency programs that affect the viability of clusters.
4. Review regulatory processes and establish mechanisms for enhanced coordination among state and local agencies.
5. Review and strengthen education and training programs that serve the needs of employers and workers in particular clusters.
6. Re-examine support for public research institutions and technology transfer.
7. Review criteria for CERB funding to ensure that cluster needs are considered.
8. Consider launching a competitive RFP process to fund cluster projects at the local level.

Introduction

This report is based on the central hypothesis that the economic success of regions depends on the competitiveness of key industry clusters in each region. A cluster consists of a lead or final product industry and this industry's suppliers, often concentrated in a particular sub-state region. Individual companies succeed or fail not just due to their own efforts, but in part because of the success of the cluster in the region due to inter-firm networks and multiplier effects. By becoming aware of cluster characteristics and key challenges and opportunities facing regional clusters, economic and workforce development agencies can do a better job of providing services that enhance regional competitiveness.

Prior work on this issue-identified key manufacturing clusters based on a national analysis of inter-sectoral ties, and suggested several criteria for choosing clusters to focus state agency efforts on.¹ In this report, more detailed data are provided about employment and revenue trends for an expanded list of clusters, including several significant non-manufacturing clusters. In addition, insights from roundtable or focus group discussions with cluster representatives in several parts of the state are utilized to provide a broad view of significant challenges and opportunities facing selected clusters, as well as the viability of cluster strategies in general from an industry point of view.

Research Process

The research process was designed to combine existing secondary data on characteristics of various clusters with focus groups involving selected cluster representatives to discover important issues facing the state's key clusters. A database was assembled with information on each candidate cluster, including trends in the number of establishments, cluster employment and revenues reported to the state. In addition, *location coefficients* (see box) were computed for each cluster for nine regions of the state as depicted on the accompanying map. State and regional location coefficients are shown on the page following the regional map. The employment and revenue data for all clusters is contained in the Appendix to this report.

The statewide location coefficients suggest that the state has significant competitive advantage in *Aerospace, Aluminum, Wood Products, Biotech, and Food Processing*. In addition, modest competitive advantage is indicated for *Tourism, International Trade, Electronics and Computers, Concrete/Cement/Brick, and Software*.

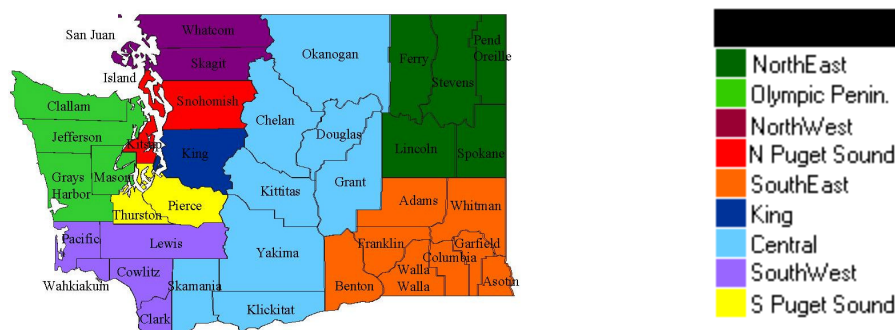
Location Coefficients

Location Coefficients (LCs) are a tool used by regional economists to measure regional competitive advantage. LCs measure the relative concentration of a given cluster in a region as compared to the nation. LCs greater than one indicate a local concentration more dense than the national concentration of the industry. When a LC is much greater than one, the cluster is assumed to be have significant competitive advantage, and it is likely to be an exporter of goods or services outside the region. Absent other information, an LC much less than one indicates a locally focused industry, or one that lacks competitive advantage.

¹ P. Sommers, *Cluster Strategies*, Seattle: Report by Northwest Policy Center for Office of Trade and Economic Development, November 2000.

Health care nearly makes the list with a statewide coefficient of 0.91 and a regional coefficient greater than one in the Northeast region. These industry clusters are candidates for further investigation.

Regions of the State



Based on the location coefficients for each cluster and region, several clusters were chosen for more detailed analysis, and a region was picked for hosting that discussion. Recommended clusters and regions are shown on the location coefficient table on the next page. Based on those recommendations, the following clusters and regions were selected after further discussions with staff of several state agencies:

Regional Clusters Selected for Case Studies

Cluster	Region (and City)
Agriculture/Food Processing	Southeast (Kennewick)
Wood products	Olympic Peninsula (Port Angeles)
Semiconductors	Southwest (Vancouver)
Biotechnology	Puget Sound (Bothell)
Measuring Devices and Instruments	Puget Sound (Everett)
Health Care	Northeast (Spokane)

This set of choices encompasses most of the clusters with a statewide location coefficient greater than one, indicating that the state has a comparative advantage in these clusters. Aerospace and Aluminum are the only two clusters omitted. In the case of Aerospace the cluster is dominated by a single major firm; issues associated with the health of this cluster and firm are well known and it was not deemed necessary to hold a focus group. In the case of Aluminum, the immediate and pressing issue is the availability and cost of electric energy. State agency representatives indicated that the state is well apprised of these issues and has held several conversations with industry representatives over the last several months. No cluster group was convened for the Software cluster despite the impressive growth of the cluster in the past decade. Reports from WSA and others have done a good job of articulating issues facing this cluster.

Location Coefficients for Washington's Industry Clusters

	Tourism	Inter- nation- al Trade	Health Care	Metal- working	Electronics and Computers ¹	Printing & Publishing	Wood Products	Non- ferrous Metals	Aerospace	Aluminum	Concrete, Cement & Brick	Food Processing	Software	Biotech	Business Services inc. FIRE
King	0.9	0.8	0.6	0.5	0.8	0.6	0.8	0.1	12.2	0.6	0.6	1.3	4.0	3.0	0.9
North Puget Sound	0.8	0.3	0.6	0.5	1.7	0.5	1.7	0.2	29.5	0.4	0.6	0.8	0.6	1.3	0.5
South Puget Sound	0.8	0.6	0.8	0.4	0.4	0.8	2.2	0.3	1.6	1.6	0.6	0.7	0.5	0.7	0.6
Olympic Peninsula	1.1	0.4	0.8	0.3	0.1	0.7	6.2	0.2	0.8	2.3	1.1	1.2	0.3	0.6	0.5
Northwest	0.9	0.6	0.8	0.5	0.5	0.4	2.8	0.2	0.2	11.0	1.5	1.5	0.5	0.6	0.4
Central	0.8	0.6	0.7	0.4	0.2	0.6	2.3	0.8	0.7	10.0	1.0	2.2	0.1	0.5	0.4
Southeast	0.8	0.4	0.8	0.3	0.5	0.5	1.0	0.4	0.7	0.6	0.5	5.3	0.6	1.5	0.4
Northeast	0.9	0.6	1.1	0.7	1.1	0.5	2.1	0.1	1.8	5.5	1.8	1.7	0.5	0.6	0.6
Southwest	0.9	0.6	0.8	0.8	1.6	0.9	3.2	0.0	0.2	10.4	0.9	0.8	0.6	0.8	0.5
WA Total	1.0	1.2	0.9	0.6	1.1	0.9	1.6	0.8	9.3	3.9	1.1	1.3	1.1	1.4	0.9

¹ Includes measurement devices and semiconductors.

The clusters chosen for more detailed analysis for the purposes of this report by no means represent a comprehensive list of clusters in Washington. Several other clusters, identified in the previous table, should also be evaluated in more detail in future efforts.

The next six sections of the report summarize economic trends and results of the focus group discussions for the six clusters listed above. Recommendations specific to each cluster are presented at the end of each of the six cluster sections. The final section contains some thoughts on public policy strategies for enhancing the competitiveness of industry clusters and criteria for selection of clusters for intervention strategies.

Agriculture and Food Processing

The Southeast region includes eight counties anchored by the Tri-Cities, Walla Walla, and Pullman. This is a diverse region economically, with many farming and food processing establishments, a high tech cluster centered near the Hanford Reservation, and a higher education sector with a major research university in Pullman and a distinguished private college in Walla Walla. Major industry clusters include Business Services, Health Care, Tourism, and Food Processing. The region has five times more of its employment in the food-processing cluster than does the nation; this high relative concentration of employment in this cluster is far higher than any other region of the state. Because of this concentration, the Southeast region was chosen to convene a group of food processing industry members to discuss the issues facing this cluster.

Employment by Cluster In Southeast Washington, First Quarter 2000

Tourism	9,573
Health Care	8,083
Business Services incl. Finance, Insurance, & Real Estate	6,536
Food Processing	5,807
Metalworking	1,155
International Trade	1,103
Printing & publishing	1,029
Electronics and computers	838
Software	813
Wood products	801
Biotech	439
Aerospace	292
Ship & Boat Building	134
Non-ferrous metals	111
Concrete, cement & brick	82
Aluminum	56
Total, all clusters	36,718
Total, all industries	111,300

Characteristics of the Food Processing Cluster

The Food Processing Cluster in Washington consists of packaged food producers such as cereal and flour producers, canning and bottling plants, and dairy and meat products plants. Many of these processing plants are located in Eastern Washington near the farms that grow the agricultural commodities being processed in the food processing plants. The related farming activities can be regarded as part of the cluster, as well as those industries that support the cluster, including trucking and other transportation systems. Historical competitive advantages of this region include access to water and power at very competitive rates, an excellent transportation system for moving products to market, and an available and affordable labor

supply. In southeast Washington, potatoes are the largest crop and as such, the food-processing sector here, specializes in potato products.

Composition

Packaged Foods (e.g., cookies, crackers, cereals, flours, pasta, roasted coffee)
 Canned & Bottled Goods
 Dairy Products
 Meat Products

Institutions

Northwest Food Processing Association
 Various commodity commissions
 Cooperative Extension

Employment in the Food Processing cluster has grown slightly in the last decade, less than the median of all industry clusters in the state. However, revenues reportable to the state for purpose of the gross receipts tax have grown somewhat more rapidly than the average of all industries, suggesting substantial productivity improvements within the cluster.

Employment

Establishments reporting employment – 1990	2,994
Establishments reporting employment- 2000	3,022
Change	28
% Change	0.9%
Employment – 1990	48,683
Employment – 2000	49,757
Change	1,074
% Change	2.2%

Revenue	
Establishments reporting revenue- 1994	283
Establishments reporting revenue- 1999	395
Change	20
% Change	4.2%
Gross Business Income – 1990 (Reportable to Washington State)	\$5.753 billion
Gross Business Income – 2000 (Reportable to Washington State)	\$7.592 billion
Change	\$1.839 billion
% Change	32.0%

Much of the food-processing cluster is concentrated near growers in rural Washington, as indicated by location coefficients greater than one in the Southeast, Central, Northwest, and Olympic Peninsula regions. However, coefficients greater than one are also found in King and the Northeast regions, indicating substantial food processing industries in these more urbanized areas.

Location Coefficients	
King	1.3
North Puget Sound	0.8
South Puget Sound	0.7
Olympic Peninsula	1.2
Northwest	1.5
Central	2.2
Southeast	5.3
Northeast	1.7
Southwest	0.8
Washington	1.3

Issues Facing the Agriculture and Food Processing Industries

Many of the historical *competitive advantages* of the cluster are in jeopardy of being lost. High energy costs pose a major cost issue for irrigators and processors. Participants in the focus group also expressed challenges involved in meeting state housing standards, which require year-round standards for housing occupied for a few months each summer. Migrant labor, essential for harvesting field and tree crops, is available, but regulatory requirements are making it increasingly difficult to employ migrants. Because there is no domestic labor supply available and skilled to harvest crops, employers are increasingly dependent on migrant labor. Furthermore, participants noted that federal immigration agencies are placing greater responsibility on employers to determine the validity of the documents a worker presents when asked for documentation of legal status. Many employees feel that they have no practical way to

determine the validity of worker documents. Finally, minimum wage rules dictate that a worker must be paid at least the minimum wage, even though a piece rate system is still in use and most competent pickers earn far more than the minimum wage. Record-keeping to ensure that each worker receives the minimum wage is considered onerous. Indexing of the minimum wage may make Washington's field crops economically non-competitive since wage costs in this state will likely rise more relative to other states.

Despite these problems, one roundtable participant described the Lower Columbia region as "an agricultural Mecca," and another participant noted that some dairy operations have re-located from Western Washington to escape urban pressures on the agricultural land base.

Globalization is also impacting the cluster. Asparagus and berry markets in the US have been met with competitive products from Chile. Similarly, Chinese apple production has created an oversupply of apples in the global market. Some suggested that Washington's orchardists will have to leave the industry before profitability can be restored. Participants acknowledge that changing market conditions coupled with consumers who are less concerned where their food is produced has contributed to the profitability of Washington farmers.

Cluster representatives would like to see a *unified state strategy* with respect to the agriculture and food processing industries. Participants suggested that the state come up with a strategic plan for coordinating the various agencies.

Wine and tourism represent an area of opportunity. The wine industry is one area of growth. There are only 30,000 acres of wine grapes in this state, so the sector is relatively small. Grapes grown for juice products are a much bigger commodity. However, the wine industry is growing in volume of products and its reputation for quality is very high. In 1999, Washington's more than 160 wineries produced more than \$288 million in revenues. Combining winery tours with tourism activities oriented around the wineries is a value-added area. Additional lodging, eating places, and associated recreational activities could be developed in the wine oriented region of the state stretching from Yakima southeast towards the Tri-Cities and Walla Walla. The state's existing wine country tourism initiative could be expanded.

Recommendations

- *Convene state agencies assisting and regulating the agriculture and food processing industries* to develop a more unified strategy with respect to this cluster. Consider initiatives to coordinate and streamline regulations and encourage innovative approaches to achieving regulatory goals. Provide technical assistance in meeting regulations and improving efficiency of operations, and assist producers and processors in responding to international competition by developing new market niches. Industry associations should be consulted as part of this initiative to facilitate input from industry on major regulatory problems.
- *Continue to support the wine country tourism initiative* by assisting companies interested in adding new overnight accommodations, restaurants, and other facilities and services to accommodate visitors. This strategy could include festivals and other special events, development of destination resorts or other facilities for visitors, and initiatives to provide

non-private auto transportation alternatives to preserve environmental quality and public safety.

- *Support Washington branding and other efforts to promote Washington grown food products to consumers.* OTED, in concert with the Department of Agriculture, could consider branding approaches to distinguish state-grown food products.

Wood products

The Olympic Peninsula region consists of four counties that are very rural in character. Much of the area is forested, with the Olympic Peninsula dividing the region. Significant industry clusters in this region include Tourism, Health Care, Business Services, and Wood Products. The Wood Products cluster has the highest location coefficient for this cluster in the state, six times the national concentration of wood products firms. Due to this concentration, the Olympic Peninsula region was selected to convene a group of wood products industry members for a discussion of issues facing this cluster.

Employment by Cluster in the Olympic Peninsula Region, First Quarter 2000

Tourism	6,722
Health Care	4,180
Business Services incl. Finance, Insurance & Real Estate	3,670
Wood products	2,679
Food Processing	700
Printing & publishing	697
International Trade	669
Metalworking	560
Ship & Boat Building	499
Software	227
Aerospace	190
Electronics and computers	122
Aluminum	115
Biotech	90
Concrete, cement & brick	87
Non-ferrous metals	27
Total, all clusters	20,735
Total, all industries	57,769

Characteristics of the Wood Products Industries

The Wood Products cluster consists of logging companies, primary product mills, and secondary wood product manufacturers. Manufacturing activity takes place in regions where trees are grown on public and private lands; these associated forestry activities can be regarded as part of the cluster. Several significant institutions including industry associations and a specialized research center focused on international trade opportunities support these private firms.

Composition

Logging
Sawmills and Planing Mills
Millwork, Veneer, Plywood, and Structural Wood Members
Wood Containers
Wood Buildings and Mobile Homes
Misc. Wood and Forest Products
Transportation

Institutions

APA Engineered Wood Association
Center for International Trade in Forest Products
(CINTRAFOR)
Evergreen Building Products Association
Western Wood Products Association

Employment in the wood products cluster has contracted over the past decade in response to reduced harvests of wood on public lands, as well as productivity improvements within the industry based on the adoption of computer controlled equipment and material handling systems. In addition, a prolonged economic slump in Japan has reduced opportunities in the major export market Washington firms have served. Despite these problems, revenues reportable to the state for purposes of the gross receipts tax have grown, reaching nearly \$6.4 billion in 2000. This is a large cluster in terms of gross receipts, and the growth of receipts at the same time as employment contraction suggests substantial productivity improvements.

Employment

Establishments reporting employment – 1990	802
Establishments reporting employment – 2000	733
Change	(69)
% Change	-8.6%
Employment – 1990	30,101
Employment – 2000	26,085
Change	(4,017)
% Change	-13.3%

Revenue	
Establishments reporting revenue – 1994	1,647
Establishments reporting revenue – 1999	1,407
Change	(240)
% Change	-17.1%
Gross Business Income – 1990 (Reportable to Washington State)	\$6.230 billion
Gross Business Income – 2000 (Reportable to Washington State)	\$6.389 billion
Change	\$0.161 billion
% Change	2.6%

Location coefficients measure the relative size of an industry in a region as compared to its size relative to total employment nationally. A location coefficient greater than one indicates a regional specialization in a cluster. The state as a whole shows a specialization in wood products, but the Olympic Peninsula has the highest regional concentration in this cluster with 6 times the employment in this cluster as compared to the nation. Other significant regional clusters are the Southwest, Northwest, South Puget Sound, Central, and Northeast regions.

Location Coefficients	
King	0.8
North Puget Sound	1.7
South Puget Sound	2.2
Olympic Peninsula	6.2
Northwest	2.8
Central	2.3
Southeast	1.0
Northeast	2.1
Southwest	3.2
Washington	1.6

Issues Facing the Wood products Cluster

Washington is prime tree growing country, and forests are a renewable resource. The resource base has always been a major strength of the industry. In the decades ahead, second and third growth stands in industrial forests will produce a very large volume of marketable timber, a supply larger than presently available as shown by a number of studies including a timber supply

study commissioned by the Clallam County EDC.² An infrastructure of roads, ports, and other facilities has been built up to support the industry, and generations of workers in the area have worked in this industry, resulting in a strong workforce advantage.

Environmental regulation has constrained access to timber in state-owned forests. This aspect of public policy is a continuing concern to the wood processing industry. Despite those concerns, some focus group participants suggested that the state's high regulatory standards, embedded in the Forest Practices Act including recent fish and wildlife amendments, could become a source of competitive strength as consumer demand for *environmentally certified* wood grows. Environmentally certified wood is wood grown and harvested in a sustainable manner, with attention not just to wood fiber production but conservation of habitat, water quality, soil productivity, and biodiversity. Several organizations have been set up to certify management practices in forests and processing plants, based on independent audits. Issuance of a certification from one of these organizations gives the producer the right to tag products in some manner so that buyers can distinguish certified from non-certified material. Responding to consumer concerns about sustainability, major retailers such as Home Depot and Lowes are offering certified wood, and some major timber producers including Simpson and Weyerhaeuser are moving towards certification. These market shifts suggest that most of the industry will have to get certified. If the state can somehow certify all lands falling under its regulation through the Forest Practices Act, major competitive advantages could be conferred on all firms in the cluster. Alternatively, forest and mill managers may have to take additional steps to meet third party certification standards. The Department of Natural Resources is examining this issue.

Prevalence of hemlock. Another concern about the supply on the Olympic Peninsula is that it is primarily hemlock, a relatively hard softwood that is difficult to nail and less appealing to the eye than fir or pine. Consequently it has a lower value than competing species, and some focus group participants indicated problems in finding mills to process it. Some mills in the region have closed down, providing an opportunity to Canadian mills that have taken over most of the market. Stands of Douglas Fir planted in the 1970s will soon become available; this supply is expected to be easier to market, even though the wood will not be of the same quality as older, more slowly grown Fir.

Engineered wood products such as plywood, oriented strand board, glued laminate, laminated veneers, and other glued engineered wood products, pose another competitive challenge. Engineered wood roof beams are becoming the standard in commercial construction, and some focus group participants reported favorable experiences with structural lumber made from engineered materials. These materials do not warp or shrink, resulting in more accurate construction of buildings. However, they are a problem for regional forestry and manufacturing because they compete with solid wood products. Most focus group participants felt that the market share of engineered products would grow, but would be limited by the higher cost of these materials.

²Attebury Consultants, Inc., *North Olympic Peninsula Timber Inventory Harvest Level Projection: Clallam & Jefferson Counties, Washington*, Beaverton, OR: Report for Clallam County Economic Development Council, August 2000.

Growing international competition is a major challenge to the industry. Chinese paper and solid wood products are a growing factor. The Canadian softwood lumber agreement has expired, and has been replaced by a U.S. imposed tariff whose legality has been challenged by the Canadians before the World Trade Organization. Canadian imports have been a major factor in the US market for many years. Japan was traditionally the best export market for Washington producers, but its prolonged recession has limited opportunities there. Thus, the international scene is a mix of competing producers and few emerging market opportunities.

This year's *energy crisis* is also a major concern. Energy prices have increased dramatically and many focus group participants expressed concern over future energy price volatility. Energy is a major cost for all wood processors, and pulp and paper plants are extremely intensive electric power users.

Public attitudes towards the forest and forest-related industries constitute a major challenge to continued profitable operations. Focus group participants suggested that a major public relations campaign may be needed to educate the public about the sustainable nature of current forest operations and the need to maintain forest roads to provide access to the resource, prevent environmental harm such as siltation from poorly maintained roads, and to fight fires. Objective research from universities is seen as one credible information source that should be encouraged. A forest tour operation operated by volunteers in Forks is perceived to have positive impacts, but it is hard to sustain and impacts only a proportionately small number of visitors to the area.

Recommendations

- *Assess market trends in relation to environmental certification of forest products* and evaluate the requirements of the state's Forest Practices Act (FPA) in relation to several alternative environmental certification standards; based on this analysis, consider development of a process to certify all lands subject to the FPA.
- *Improve coordination of state programs that provide technical assistance to forest products companies*, including Washington Manufacturing Services, Cooperative Extension, conservation programs in the Department of Natural Resources, and business assistance programs in the Office of Trade and Economic Development, seeking opportunities to improve firms' production efficiencies and assist firms interested in entering new markets; identify opportunities to coordinate services among these programs

Health Care

Health Care is a large cluster in Washington, employing nearly 175,000 workers in the first quarter of 2000. However, a comparison of health care employment to total employment reveals that Washington has a somewhat smaller percentage of total employment in the health-related sectors than does the United States as a whole. The location coefficient for Washington's health care sector is consequently less than 1 (0.91 to be precise). While the state as a whole does not appear to be specialized in health service, one region, the Northeast, does have a location coefficient greater than one indicating a regional specialization in this cluster. Health Care accounts for about 10 percent of total employment in the Northeast region. Two major hospital systems have facilities in Spokane. The local colleges have organized an inter-collegiate education center to support the cluster, and a heart-related center has been established. Because of these characteristics of the Health Care cluster in the Spokane area, this regional cluster was selected for preliminary discussions with cluster representatives.

Employment by Cluster in the Northeast Region, First Quarter 2000

Health Care	17,217
Tourism	15,569
Business Services incl. Finance, Insurance & Real Estate	15,170
Metalworking	4,060
Electronics and computers	3,157
Food Processing	2,999
International Trade	2,808
Wood products	2,733
Printing & publishing	1,550
Aerospace	1,237
Software	1,108
Aluminum	807
Concrete, cement & brick	433
Biotech	260
Ship & Boat Building	148
Non-ferrous metals	47
Total, all clusters	69,156
Total, all industries	174,214

Characteristics of the Health Care Cluster

The Health Care cluster is composed of several sectors including offices of health care professionals, nursing establishments and services, hospitals, and laboratories. While it is not possible to detect the existence of specialized wholesalers and other suppliers to the cluster from available employment data, local cluster representatives consider these suppliers part of the cluster. Major institutions in the state such as the University of Washington medical school,

community and technical college programs in health fields, the Association of Washington Hospitals, and professional associations such as the American Medical Association support the cluster.

Composition

Offices and Clinics of Doctors of Medicine
Offices and Clinics of Dentists
Offices and Clinics of Doctors of Osteopathy
Offices and Clinics of Other Health Practitioners
Nursing and Personal Care Facilities
Hospitals
Medical and Dental Laboratories
Home Health Services
Misc. Health and Allied Services NEC

Institutions

UW Medical School
Association of Washington Hospitals
American Medical Association

Statewide, the cluster consists of over 6800 business establishments, up nearly 30 percent from 1990. Employment stands at nearly 217 thousand, up 28 percent from 1990. Gross Business Income reportable to the state has grown to \$13.2 billion, up 34 percent from 1990. This cluster appears to be a strong and growing part of the Washington economy.

Employment

Establishments reporting employment – 1990	5,307
Establishments reporting employment- 2000	6,864
Change	1,557
% Change	29.3%
Employment – 1990	168,983
Employment – 2000	216,618
Change	47,635
% Change	28.2%

Revenue	
Establishments reporting revenue – 1994	15,323
Establishments reporting revenue – 1999	12,836
Change	(2,487)
% Change	-19.4%
Gross Business Income – 1990 (Reportable to Washington State)	\$9.876 billion
Gross Business Income – 2000 (Reportable to Washington State)	\$13.223 billion
Change	\$3.347 billion
% Change	33.9%

Location Coefficients	
King	0.6
North Puget Sound	0.6
South Puget Sound	0.8
Olympic Peninsula	0.8
Northwest	0.8
Central	0.7
Southeast	0.8
Northeast	1.1
Southwest	0.8
Washington	0.9

Major Issues Facing the Cluster

The Health Care cluster is expanding nationwide due to the aging of the U.S. population. This national trend, plus the tendency of older people to retire in Washington, suggests that the cluster will continue to grow. Other factors contribute to growth opportunities in Washington, including the presence of specialized facilities for cancer, heart, and burn treatment.

Payment systems. The Health Care cluster is challenged by reorganization of payment systems and internal mergers and acquisitions that are in part a response to the financial pressures caused by those changes in payment systems. With health care costs accounting for an increasing share of GDP, it is likely that public policy changes and employer cost control strategies will induce further structural changes in the Health Care industries. Pressure on profit margins is making it difficult for hospitals to complete needed expansion programs. In Spokane, over \$360 million in expansion is currently underway.

One outcome of these changes is larger and more integrated service providers, making it difficult to maintain services in smaller communities. This factor, however, works to the advantage of regional service centers such as Spokane, Seattle, and Tacoma. For the Health Care clusters in

these three cities, the salient issue may be how to effectively extend services into smaller communities using telemedicine, rapid movement of patients requiring specialized services and facilities, and other strategies.

Informatics is a developing regional competence in the Spokane area. According to the Columbia University medical school, “medical informatics is the scientific field that deals with the storage, retrieval, sharing, and optimal use of biomedical information, data, and knowledge for problem solving and decision making. It touches on all basic and applied fields in biomedical science and is closely tied to modern information technologies, notably in the areas of computing and communication.”³ By linking the databases of hospitals, referring physicians, nursing centers, and other establishments, data entry costs are reduced and data sharing improves the overall efficiency and responsiveness of the health care system. Organizations in the Spokane area have been pioneers in developing informatics systems, and cluster representatives see this as a source of competitive advantage.

Several hundred *clinical trials* of new pharmaceutical products are underway in the Spokane area. This is considered a relatively large number for a city of the size of Spokane and reflects favorable demographics for this process as well as a deliberate strategy the area is using to build up a biotechnology industry. Three contract manufacturers of biotechnology products are currently located in the area. Local leaders hope that the combination of clinical trials, informatics capacity, existing firms, new research centers such as the heart institute, and support from individual researchers and a Reproductive Technology center at Washington State University will aid the area in building a biotechnology cluster to complement the health care cluster.

A number of *workforce issues* need to be addressed in the Spokane area. There is a shortage of nursing personnel, and with the average age of nurses in the mid-forties, this problem will likely get worse over time. There has been significant attrition of dentists locally via retirement. In general, it is difficult to recruit medical specialists in to the area. Pediatricians are particularly a problem due in part to low reimbursement rates. Among non-professional positions such as radiologists, a skill gap exists as the technology continues to advance. The range of workforce issues raised at a focus group in Spokane is quite large, with some problems requiring action by medical schools and others resolvable by programs at the community college level. These issues require a more detailed investigation.

Another policy issue requiring attention is care for *indigent patients*. In the Seattle area, specialized facilities provide care to indigent populations, but in Spokane, every hospital is required to provide care to this population because there is no specialized facility for this purpose. However, pressure on rates under public programs make care for indigents unprofitable, and continued care by all hospitals is not viable under current rate structures.

Collaboration among specialized providers is excellent in the Spokane area and this is a strength of the cluster. Another strength is a substantial number of *clinical trials* (over 300) underway in the area due to favorable demographics. These trials may help the region in developing a

³ <http://www.cpmc.columbia.edu/>

contract biotechnology manufacturing industry as the region builds its reputation in the health care industries.

Recommendations

- *Support efforts to promote regional health care clusters such as the one in Spokane.* The Spokane area has the potential to become a Northwest version of the Mayo Clinic, i.e., a destination for specialized but very well coordinated health care in such fields as heart disease, cancer treatment, and rehabilitation services that benefit from a health care team approach consistent with Mayo philosophy. Such a strategy could feature local advanced informatics capacity as a cost-reducing element in the team-oriented “Mayo clinic” approach; it may also include low cost housing and telework center accommodations for family members who wish to live near patients during extended treatment/rehabilitation processes. State roles in this strategy could include facilitation of the development of an implementation plan, assistance with any new IT infrastructure needed to improve informatics capacity among participating organizations, and funding for feasibility studies for new research centers.
- *Support development of biotech manufacturing and related biotech/biomedical industry segments* who may find the Spokane area a competitive site due to favorable wage rates, low land costs, existing workforce skills, support from Washington State University and SIRT, and the base of existing companies in the area; elements of a strategy for biotech/biomedical cluster development could include support for research programs, development of specialized patient care facilities, marketing to biotech companies whose product development processes are approaching the clinical trials stage, marketing to bring additional contract manufacturers into the area. State roles in this strategy could include assistance or participation in marketing campaigns, support for research programs, and timely development of specialized higher education programs that may be required to provide local residents the opportunity to get jobs in this emerging cluster.

Biotechnology

Bothell was chosen as a site for a biotechnology cluster roundtable because most of the members of the cluster are located either in Seattle, near the research centers and patient care facilities, or in modern industrial parks in northern King and southern Snohomish counties. The City of Bothell is located partly in King and partly in Snohomish, making this city a uniquely suitable site for the roundtable. King County has a location coefficient of 3.0 for this cluster, and the Northern Puget Sound region, which includes Snohomish County, has a location coefficient of 1.3. No other region of the state has a location coefficient greater than 1 except for the Southeast region with a location coefficient of 1.5. Based on research at Battelle and agricultural as well as pharmaceutical applications, a distinctive biotechnology cluster may be growing in the Southeast that is quite different from the one in King/Snohomish.

Regional Location Coefficients for Biotechnology

King	3.0
North Puget Sound	1.3
South Puget Sound	0.7
Olympic Peninsula	0.6
Northwest	0.6
Central	0.5
Southeast	1.5
Northeast	0.6
Southwest	0.8
Washington	1.4

Characteristics of the Biotechnology Cluster

The biotechnology cluster in Washington is composed of commercial firms and research organizations, many of which are engaged in primarily in research and development processes with the hope of discovering products that will have enormous commercial value. As the Washington Biotechnology and Medical Technology Annual Report notes “Washington State companies stand on the threshold of major breakthroughs that will revolutionize medical diagnostics and therapeutics, agriculture, and a wide variety of industrial processes with increasing economic benefit locally, as well as globally.”

There is no biotechnology sector as such in the industrial taxonomies in use today – Standard Industry Classification (SIC) or North American Industry Classification System (NAICS). Firms we think of as biotechnology firms are classified either as research organizations, pharmaceutical manufacturers, or chemical manufacturers. The Washington Biotechnology & Biomedical Association membership directory lists 181 companies and organizations in its membership directory, another way of assessing the size and composition of the clusters. As a rough

approximation, employment and revenues in the following industrial sectors can be thought of as comprising the “biotechnology” cluster.

Composition

Commercial Physical and Biological Research

(many for-profit biotechnology companies are classified in this category)

Non-Commercial Research Organizations

(including Fred Hutchinson Cancer Research Center and other non-profit research institutions such as Battelle and Virginia Mason Research Center)

Pharmaceutical Manufacturing

Venture Capitalists

Venture capital plays a critical role in this cluster due to 10-15 year periods of intense research and development that typically precede the introduction of a commercial product. Specialized venture capital pools are required to support this lengthy lag between startup and self-sustaining revenues from product sales, or licensing and royalty fees.

A number of research and other institutions provide support to this cluster. Federal research support coming into the non-profit and university based research institutions has totaled over \$17 billion since 1980, including \$1.4 billion in 2000. The largest research area within this federally funded research is biotechnology. In addition, 23 publicly traded biotechnology and medical device companies invested more than \$476 million in research and development in 2000 (2001 Washington Biotechnology & Medical Technology Annual Report).

Institutions

University of Washington School of Medicine

Washington State University

Washington Biotechnology and Biomedical Association

Washington Biotechnology Research Foundation

Seattle Cancer Care Alliance

Technology Alliance

Using the SIC –based industry categories listed above to capture the range of organizations comprising the biotechnology cluster leads to an estimate of over 500 firms who may currently be involved in the cluster, with an employment level of 14,500 in 2000. The Washington Biotechnology & Medical Technology Annual Report estimates the size of the biotechnology industry in the state at 9,000 employees in 2000.

Employment	
Establishments reporting employment – 1990	235
Establishments reporting employment – 2000	534
Change	299
% Change	127.2%
Employment – 1990	9,221
Employment – 2000	14,534
Change	5,313
% Change	57.6%

Revenue	
Establishments reporting revenue – 1994	362
Establishments reporting revenue – 1999	329
Change	(33)
% Change	-10.0%
Gross Business Income – 1990 (Reportable to Washington State)	\$1.241 billion
Gross Business Income – 2000 (Reportable to Washington State)	\$2.040 billion
Change	\$0.799 billion
% Change	64.4%

Issues Facing the Cluster

The biotechnology industry has grown substantially in the past decade, but seems to be poised on the edge of a dramatic new round of growth. Basic research continues, opening up many new potential applications for life sciences technologies, in many fields not just the pharmaceutical and agricultural applications with which the industry is currently associated. To seize this promising future, the state needs to provide strong support for science and mathematics education at all levels of the educational system, and provide support for the basic research in public universities that provides the intellectual springboard from which commercializable technologies emerge. In addition, the technology transfer process could be augmented and strengthened in several ways. In addition, facilities and infrastructure are needed to support further growth of the cluster. These issues are explored more fully below.

The strength of *basic science and mathematics education* in K-12 education, as well as colleges and universities, is a key factor for the future success of this cluster. Not only is a high level of competence in these fields needed in the cluster's workforce, but a strong science background also helps the general public understand both the potential of the cluster and its inherent

characteristics. Whether it is fire protection codes or concerns about laboratory uses of animals, the general public's understanding and acceptance of the cluster is essential, and one reason for strong science programs in the schools. On the workforce side, the need for a good science background is widespread among supporting industries as well as in the biotechnology firms themselves, for example. Lawyers dealing with intellectual property issues need some understanding of the underlying science.

A second concern of cluster representatives is continued *support for the basic research* from public universities. While this state is not currently a direct supporter of research projects, other states have used tobacco settlement funds to directly support research. Given the fiscal circumstances of the state, a more feasible way to support basic research might be to appropriate capital budgets to support expansion of laboratory or other space needed by the research universities.

Another area that needs to be strengthened is *technology transfer*. Focus group participants suggested that the staff of the technology transfer office at the University of Washington should be expanded, and that salaries should be increased sufficiently to retain senior staff. Funding for patenting is very limited, coming mainly from funds earned through prior patents and licenses. In essence, the University of Washington only patents technologies for which there is a likely private sector licensing agreement that will pay the cost of obtaining domestic and international patents. The limited internal funds are used only in very special cases with potential long-term benefits but at an early state when no private sector licensing is possible. These limitations cannot be easily removed because the university is primarily a teaching and research institution and cannot apply private sector tactics easily without running into conflicts with policies stemming from its teaching and research missions. Participants proposed that if the state can craft policies to help the university build up its technology transfer capacity, this would likely result in additional partnerships with local companies.

It is important to recognize that technology transfer takes place in several different ways, and licensing and patenting are not the only two options. The University of Washington also has a very substantial industry funded research program, in effect a way for companies to contract with specific research groups. This program is the largest of any university in the country, and offers another mechanism for developing and transferring technology to the private sector.

One limitation in the Puget Sound region is *wet lab space for startup operations*. There is no incubator or leasable space in which a startup could conduct its laboratory operations, nor are private developers willing to develop very expensive wet lab facilities on a speculative basis. Since many of the new ideas for biotechnology are likely to emerge from university laboratories, one solution to this problem might be a research park with some incubator space as well as room for facilities developed by private companies and by the university or other research institutions. The University of Washington is considering such a research park at a site it acquired as a potential branch campus site.

Regional diversification is another area of opportunity. While this cluster is currently housed mostly in King and Snohomish counties, close to the largest research institutions, at least two other regions seem to have the essential characteristics to develop a stronger biotechnology

sector over time. Because of the research institutions at Hanford, the Tri-Cities may become a stronger player in biotechnology, particularly in agricultural and industrial applications consistent with the nature of the surrounding economic region. Bio-fuels is one possible focus for a southeastern region biotechnology industry. The Spokane area is deliberately positioning itself through developing medical research institutions and cultivating the area as a site for clinical trials (see section on Health Care). Several contract manufacturers are operating in the area, meeting the needs of biotechnology companies for clinical trials. This provides an institutional and industrial base that Spokane area leaders hope will grow significantly over time.

Siting limitations. Two issues currently limit the sites that biotechnology companies will consider in the Puget Sound region. Broadband telecommunications capacity is improving and may someday result in instantaneous face-to-face communications systems that will eliminate many of the requirements for in-person meetings, and open up additional siting options for biotechnology facilities. Access to materials in the University of Washington medical school library is another area where more on-line services could open up additional siting options. Potential sites also require specialized garbage handling services to handle biological products and other materials that cannot be sent to a standard municipal garbage facility. Currently, there is only one company that provides these services in the Seattle area, and its willingness to serve particular sites is a constraint.

Recommendations

- *Collaborate with the Office of the Superintendent of Public Instruction* to ensure that excellence in science and mathematics are an integral part of education reform and the Certificates of Mastery (to demonstrate student proficiency in various areas) that schools will issue in the future; ensure that appropriate curricula are used linking science and mathematics to applications in important Washington industries such as biotechnology and information technology.
- Work with research institutions, industry associations, and interested private companies to *establish one or more facilities providing wet lab and office space for start-up biotechnology companies*. State roles could include convening to develop a strategy, support for classic incubator functions such as technical assistance to entrepreneurs, linkages to education and research institutions, and resolution of regulatory and tax issues that may arise.
- *Create a more aggressive technology transfer program at the University of Washington*, including attention to financing, staff recruitment and retention, integration with other commercialization initiatives such as a research park or incubator facility, and linkages to various education initiatives including business education as well as hard science fields that are relevant.
- *Continue to invest in basic research to support emerging high-tech clusters, including biotechnology.*

Electronics and Computers

The Electronics and Computers cluster is a very large and diverse grouping of companies that manufacturer products with significant electronic components. It includes the semiconductor and related companies who make the basic parts, as well as instruments, computer, and other final product manufacturers who combine the parts into useful products. For this broad cluster, two focus groups were held, one with measuring instruments companies in Everett, and one with semiconductor companies in the Vancouver area.

Characteristics of the Electronics and Computers Cluster

The electronics and computers cluster is a broad group of industries making electronic products or components of such products. Computers and various kinds of instruments are the major end products, although a variety of other communications, office, and industrial devices fall within this cluster if electronic systems are involved.

Composition

Electronic computers & components
Electrical machinery & components
Instruments of All Types
Communications Equipment
Search and Navigation Equipment
Plating and Polishing
Laboratory Apparatus
Nonferrous Wire Drawing & Insulating
Magnetic & Optical Recording Media
Office Machines

Several industry associations support firms in this cluster. The AeA, formerly known as the American Electronics Association, provides represents this cluster in public policy discussions, and offers education and informational programs. The Technology Alliance is composed of companies in a wide range of high tech industries who come together around programs of mutual interest such as outreach to K-12 educational institutions to enhance staff skills and interest youth in high tech careers. Several local areas have formed high tech councils including groups in Spokane and Vancouver who work on issues of significance in their own local region of the state.

Institutions

AeA Washington Chapter
(formerly the American Electronics Association, WA
Chapter)
Technology Alliance
Local High Tech Councils (e.g., Spokane, Vancouver)

The Electronics and Computers cluster employed over 34,000 workers at more than 500 establishments in 2000, up significantly over the last decade. This cluster has grown more rapidly than the median of all industry clusters in the state. Revenues reportable to the state for gross income tax calculations have also grown more rapidly than the median of all industry clusters.

Employment

Establishments reporting employment – 1990	395
Establishments reporting employment – 2000	531
Change	136
% Change	34.4%
Employment – 1990	25,913
Employment – 2000	34,081
Change	8,169
% Change	31.5%

Revenue

Establishments reporting revenue – 1994	382
Establishments reporting revenue – 1999	382
Change	-
% Change	0.0%
Gross Business Income – 1990 (Reportable to Washington State)	\$2.755 billion
Gross Business Income - 2000 (Reportable to Washington State)	\$3.726 billion
Change	\$0.951 billion
% Change	34.5%

Location coefficients measure the relative size of a cluster in a particular region compared to its size nationally relative to total national employment. A value greater than one indicates that a region has a relatively large concentration of employment in this cluster. North Puget Sound and the Southwest region stand out as significant regions for the Electronics and Computers cluster in Washington with location coefficients of 1.7 and 1.6 respectively. These are quite high for regional location coefficients, indicating very strong cluster concentrations in these two regions of Washington.

Location Coefficients	
King	0.8
North Puget Sound	1.7
South Puget Sound	0.4
Olympic Peninsula	0.1
Northwest	0.5
Central	0.2
Southeast	0.5
Northeast	1.1
Southwest	1.6
Washington	1.1

Characteristics of the Measuring Instruments Cluster

The region with the highest location coefficient for the Electronics and Computers cluster is North Puget Sound, with a location coefficient of 1.74. This is the second largest location given coefficient for the North Puget Sound region, with aerospace occupying the top spot presence of a large Boeing facility at Paine Field in Snohomish County. Everett was chosen as the site for a measuring instruments cluster discussion based on the strong location coefficient for Electronics and Computers, as well as strong local interest in maintaining the vitality of the instruments cluster.

**Employment by Cluster in the North
Puget Sound Region, First Quarter 2000**

Aerospace	29,562
Tourism	22,041
Business Services incl. Finance, Insurance & Real Estate	17,116
Health Care	14,720
Electronics and computers	7,100
Metalworking	3,928
Wood products	3,191
International Trade	2,146
Printing & publishing	2,130
Food Processing	2,051
Software	1,862
Biotech	908
Ship & Boat Building	429
Concrete, cement & brick	211
Non-ferrous metals	119
Aluminum	89
Total, all clusters	107,174
Total, all industries	251,432

Issues Facing the Measuring Instruments Cluster

Measuring instruments are used primarily in industrial settings to diagnose process conditions. Each company makes many distinct products for relatively low volume, specialized markets worldwide. In Snohomish and north King counties, the cluster includes 10-15 companies, including an important supplier of surface mount components, as well as firms that manufacture and/or distribute end products to customers.

Globalization. The market for these products has been international for many years. Fluke Instruments, for example, has had a presence in Europe for a long time. Now, however, markets are available globally, and a combination of cost pressures and slowing market conditions reflecting the worldwide economic slowdown have forced companies to completely re-evaluate their production arrangements, marketing tactics, and other aspects of their business models. While companies traditionally designed, built, and assembled their own products, many are now out-sourcing many aspects of manufacturing. One firm represented at the focus group has outsourced all of its manufacturing except for final product assembly. A second firm is out-sourcing more and more of the component production, driven partly by the high costs of surface mount technology, which requires a large volume to be competitive. A third firm was spun out of a more diversified electronics products company because of differences in the way measuring instruments are built and marketed in comparison with other products of the parent company. A trend that is now becoming apparent is a switch to out-sourcing of design and engineering. Essentially, anywhere the right engineering capacity exists, these companies are willing to

contract with firms that will enable them to produce the best possible products. Even basic product engineering can be contracted out now to achieve greater efficiency.

Sourcing decisions are driven by the need to survive more than any other issue. Measuring instruments is a mature industrial sector and to stay viable firms must find ways to cut costs. In the recent past it was possible to earn a premium over the domestic product price in Europe or other regions of the world; this premium no longer exists in any part of the world due to new global competitors and more efficient transportation systems. Taking a global view of production decisions is necessary to stay competitive. China is an especially interesting place to seek suppliers due to strong engineering education programs and favorable cost structures.

Loss of regional advantages. Given the competitive situation and market outlook for the measuring instruments cluster, little employment growth is likely. However, firms in this cluster located in the Puget Sound because of the high quality of life that existed 10-20 years ago, a strong education system, local universities that provided an engineering talent pool, an international airport was readily accessible, and because electric power and clean water was readily and inexpensively available. Focus group participants expressed that traffic congestion and uncertain power supplies have contributed to the erosion of two of the historical competitive advantages of the region. Rolling blackouts are devastating to anyone in the industry involved in chip fabrication; a single blackout can have impacts lasting for months as a batch of chips is ruined and re-starting the process is very time consuming. While the education reform process of the state is lauded, industry member worry that it could be sidetracked before it has a chance to produce more graduates with strong math and science skills. At the university level, participants believe capacity in engineering programs is not sufficient to meet industry needs. In addition, many suggested that another weakness of the region is the unpredictable nature of land use permitting. Predictable timing of decisions is necessary to keep a project on track, but the current regulatory process is not predictable.

The combined pressures of international market forces and changing conditions in the local area are making economic viability questionable. Given the traffic congestion that has developed and a more diverse workforce, suburban fringe locations are less desirable than they were 20 or 30 years ago. On the other hand, urban land costs are so high that remote locations are the only feasible ones. Energy costs are also reducing competitiveness. When the international issues are brought in, as well as improved telecommunication and long distance transportation systems, business locations outside Washington are becoming much more competitive relative to the current sites of these firms.

Characteristics of the Semiconductor Cluster

The Southwest region of the state consists of five counties anchored by the Vancouver metro area. Significant industry clusters account for nearly 40 percent of all employment in this region. The largest clusters are tourism, health care, and business services, but several manufacturing clusters are also significant including Computers and Electronics, Metalworking, and Wood Products. Computers and Electronics stand out in this region as a cluster with a stronger regional dominance than it has nationally. This cluster includes the semiconductor plants that have given

the region so much visibility in the last few years. A roundtable with semiconductor industry representatives was held in the Vancouver area.

**Employment by Industry Cluster
in Southwest Washington, First Quarter 2000**

Tourism	17,502
Business Services incl. Finance, Insurance & Real Estate	13,155
Health Care	13,068
Electronics and computers	4,513
Metalworking	4,396
Wood products	4,307
International Trade	3,063
Printing & publishing	2,586
Aluminum	1,573
Food Processing	1,471
Software	1,314
Biotech	380
Ship & Boat Building	243
Concrete, cement & brick	234
Aerospace	140
Non-ferrous metals	19
Total, all clusters	67722
Total, all industries	178576

Issues Facing the Semiconductor Cluster

The semiconductor industry formed in the Vancouver area when RCA and Sharp established a joint venture to establish a plant at Camas. Low cost power, a trainable workforce, a high quality of life, and public support for needed infrastructure were some of the local factors that made the area attractive. When RCA was purchased by another company and the successor withdrew from the Camas partnership, Sharp took over the entire project. Other semiconductor and related computer parts plants followed this initial facility.

Loss of regional advantage. Power availability and cost, transportation, and local anti-growth sentiment are three of the major competitive challenges facing the industry. Industry representatives suggested that many of the competitive advantages that brought firms into the area have been eliminated. The industry does not believe it can count on public support for its investments. In addition, they indicated that *regulatory processes* have grown more complicated and less predictable. One focus group participant noted that final approval of his building plans will not be completed until after the construction is virtually complete. If final permits are not issued, or come with unacceptable conditions, the company will be forced to write off the investment. This participant contrasted this situation with his experience in Northern California, where all permitting relating to a construction process was completed before construction commenced. Certainty or predictability of the regulatory process is as important as the

regulatory standards; managers need to know what the rules are so they can manage rationally. Another participant noted that his company's investments were contingent on a sales tax credit that is now being disputed by a state agency. Without the credit, the investment would be unprofitable in his view, but no advance ruling on the applicability of the credit was possible.

Participants recommended that the state undertake a benchmarking study to see how Washington compares on tax, regulatory, energy and other factors. Semiconductor plants can be placed in many locations so it is important to know how this state stacks up against competitive locations. Generic studies of this sort have been done in the past but not a study using the unique characteristics of a semiconductor fabrication facility.

Workforce characteristics were one of the factors that drew firms into the area, and for entry-level production workers, local institutions provide good support. However, for professional level engineering personnel, most companies suggested they recruit out of California universities, because of the lack of science and engineering graduates in Washington. Local companies have been trying to bring in a private degree program and get it hosted locally, but there have been problems in getting the degree granting authority established. Another shortcoming in university curriculum industry representatives discussed is electronic design because companies are establishing design centers in the area. They indicated that electronic design is not a strength that any Washington institution has, and to keep the cluster competitive, eventually a 4-year technical university program is going to be needed in the area.

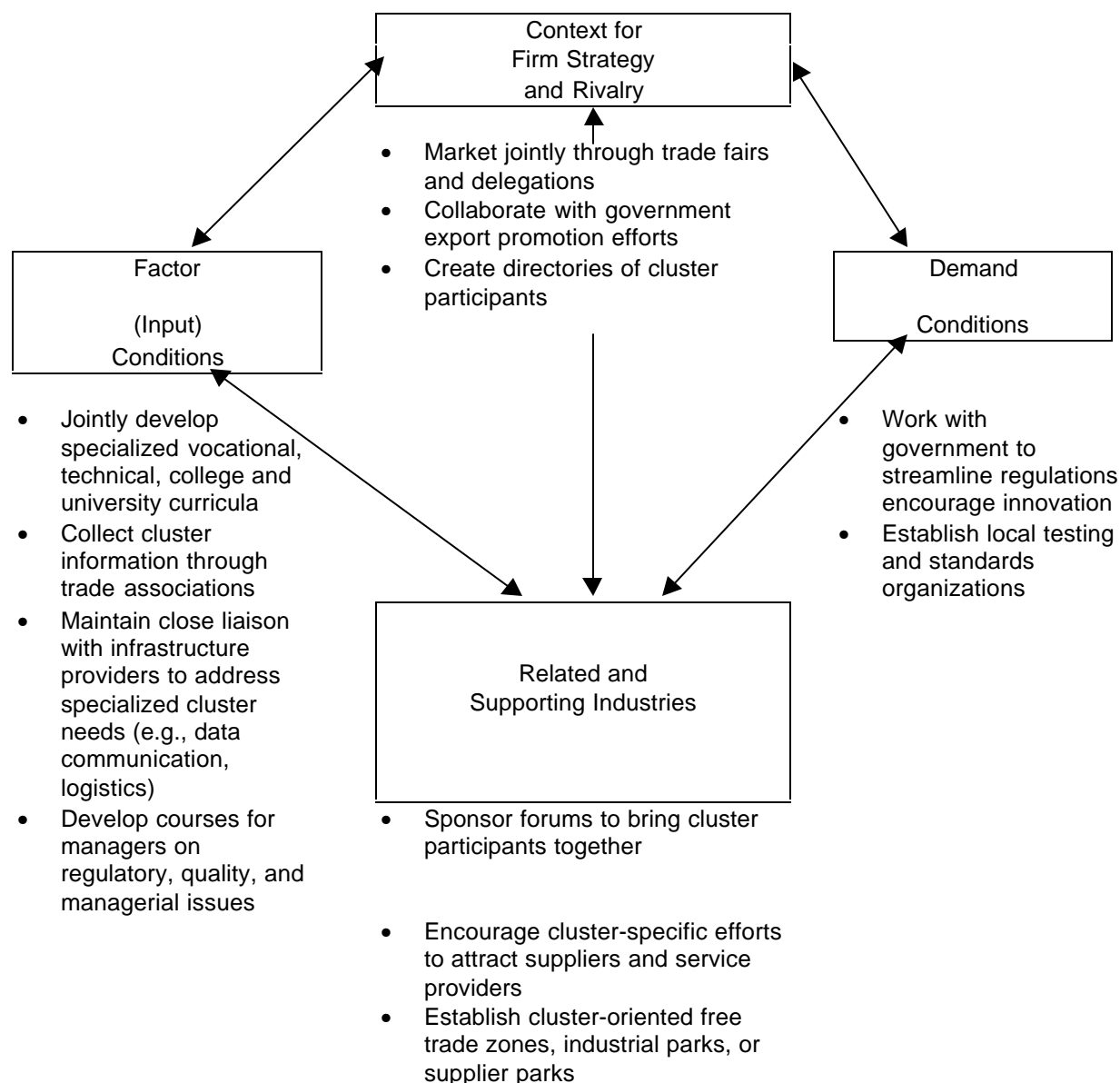
Recommendations

- *Examine support from local education institutions for key development needs of local electronics/computer related sectors*; establish new degree granting authority for those institutions that are willing to support local companies in new ways, particularly in advanced engineering fields.
- *Re-examine regulatory processes relative to site development* and develop a strategy to improve predictability and shorten the time required to reach decisions on environmental and other issues that hold up permitting.

Cluster Strategy

This section reviews ideas about cluster strategies from several leading authors on this topic and develops recommendations for actions by state agencies that could assist the development of many industry clusters in this state. The recommendations at the end of this section are of broader scope and potentially have a greater impact than the suggestions specific to each cluster that are presented above.

Michael Porter, one of the most thoughtful writers on cluster strategies, suggests that his familiar “diamond analysis” can be used to develop a typology of public policy approaches to cluster development. He stresses that all clusters should be supported to remove cluster strategies from the realm of industrial policy, or “picking winners and losers.”



In several public policy categories listed in Porter's diagram above, Washington is already quite active:

- *Setting the Context for Firm Strategy and Rivalry*: International market promotion for targeted industry clusters was a strong feature of the International Trade Division strategy in the 1980s; the Division also assisted Foreign Direct Investment especially in the wood related industries during this decade. These cluster-targeted approaches could be re-invigorated. Existing industry associations provide cluster directories, a function the public sector does not need to duplicate in many clusters.
- *Demand Conditions*: Streamlining of regulations is an existing policy in this category, with active discussions going on about forest practices, ergonomics, and other issues. The idea of establishing local testing and standards organizations has arisen in at least one context, namely forest practices. It is possible that compliance with the state's Forest Practices Act could serve as an alternative to "green certification" for forest products producers; the Department of Natural Resources is considering this issue at present.
- *Factor (Input) Conditions*: The state has assisted the formation of several trade associations in the past. Specialized vocational programs and selected cluster-focused research institutions have been supported by the state for many years. The state has only periodically supported cluster-specific information gathering, although several of those efforts have been supported recently. There is an existing mechanism for support of infrastructure investments, although proponents of a specialized cluster investment would have to make a case for it under the rules of the CERB, which are more oriented to company-specific projects with the potential to provide broad public benefits.
- *Related and Supporting Institutions*: The state has recently completed a round of cluster roundtables; the Significant Issues sections of this report are based on those roundtables. Periodic convening of similar roundtables could be an effective business-to-government communication strategy in the future. Few supplier problems were discovered in these roundtables, making the remainder of this corner of the Porter diamond less relevant than the other three, except in the case of the Semiconductor cluster in Southwest Washington. Participants in that roundtable noted that the industry is interested in establishing design capacity in the United States to get closer to customers and better understand their preferences. Development of this type of facility in Washington may require some augmentation of the offerings of education institutions as well as additional research on industrial design issues.

Given that record of support for cluster strategies in each corner of Porter's diamond, the question the state now faces is how to create the greatest public good through further cluster-oriented investments. One solution to this question is to develop criteria through which state level decision-makers can evaluate diverse benefits of specific proposals that come from cluster roundtables and other existing processes of state agencies. The set of roundtables conducted for this project yielded ideas for regulatory streamlining, standard setting, education, workforce development, financial incentives, and support of research institutions. These suggestions could

be evaluated in light of the value added, employment, generation of tax revenues, and other benefits of each cluster, as well as the requirements for state resources in each suggestion. Another approach, assuming that a budget could be assembled for a cluster initiative, would be to outline the broad parameters of acceptable cluster initiatives in an RFP and let local groups propose initiatives, providing evidence of prospective public benefits in their applications. This approach has been used recently to elicit ideas for high demand occupation education initiatives and in the past for projects linking urban and rural areas to mutual advantage.

The RFP approach has the advantage of stimulating creative ideas from a variety of local actors. However, those actors may not understand the basic concepts of a cluster approach and they may not be thinking about how to best leverage the resources of state government. A variation on this approach would be to require potential bidders to attend a training session prior to developing their proposals. Leading thinkers and practitioners on cluster strategies could be brought in to talk about what has worked in other regions. State agency representatives could present ideas on how state resources could be leveraged in support of local area initiatives. Following this training process, bidders would construct their proposals.

Stuart Rosenfeld, a well-known consultant on economic development and workforce strategies, has written several pieces on cluster strategies from the more pragmatic perspective of a consultant working for public agencies in a number of states. He notes that cluster-specific governing bodies have been established in a number of US regions. Such institutions can identify common needs, develop a collective vision, and build business and learning relationships. Learning strategies are popular among businesses, but the benefits of these groups are sometimes difficult to quantify. Cluster initiatives have also been used to:

- Strengthen inner city economies;
- Boost high tech industries in North Carolina, Colorado, and Oregon;
- Focus entrepreneurial activity in distressed areas;
- Promote exports;
- Provide a rationale for targeting education and training programs

Descriptions of a number of specific cluster initiatives are provided in an appendix to Rosenfeld's report.⁴

These cluster strategy models remind the reader that there is an underlying public policy purpose for a cluster strategy. One needs to identify the goal of a public initiative and before potential the tactics for reaching that goal can be assessed. State support for cluster-focused initiatives is not likely if the only outcome is further income for owners of firms in the targeted clusters. Publicly valued benefits are also needed, such as strengthening lagging regions of the state or enhancing job prospects for lower income state residents.

In Europe, several countries or sub-national regions have adopted cluster strategies. Philip Raines, a scholar at the University of Strathclyde, has reviewed a number of these regional

⁴ Stuart Rosenfeld. "Backing Into Clusters: Retrofitting Public Policies." Chapel Hill, NC: Paper by Regional Technology Strategies, for the John F. Kennedy School Symposium, Harvard University, March 29-30, 2001.

cluster policies.⁵ Clusters can be based on inter-firm linkages or value chains, or on certain common competencies that have applications in many sectors. The first type of cluster is represented in this state by semiconductor companies, who have ties to capacitor manufacturers and computer companies, and the measuring instruments companies, who rely on a local custom semiconductor fabricator. The second type of cluster is evocative of the biotechnology/biomedical cluster in Washington, which is developing technologies with applications in a variety of fields including pharmaceutical manufacturing, agriculture, and energy production. In addition, the instruments cluster in Washington provides process control diagnostic equipment to firms in many different industries, again suggesting a competency-based cluster. These differentiations are important because cluster strategies will vary significantly between these two types of networks. Value chain clusters may focus on missing links in the chain and provision of necessary resources such as skilled labor (semiconductors) or natural resources (forest products). Competency-based clusters may emphasize research support, broad support for science and technology education, and measures to market the region as a center of excellence in certain technologies.

Raines suggests that cluster policy development typically follows a five-stage process:

1. Economic audit
2. Policy audit
3. Policy design and commitment
4. Measures/implementing
5. Monitoring/evaluation

The economic and policy audit stages described by Raines mirror the process used in Washington's cluster strategy: analysis of cluster characteristics based on secondary data, consultation with cluster representatives, and a review of existing policy issues based on comments from cluster representatives. Cluster selection then takes place, based on criteria such as:

- Ability of policy to influence a cluster;
- Complementarity of sectors;
- Ability of secure private sector participation;
- Widespread political support for policy; and
- Budget limits.

The policy design stage has taken different directions in Europe, depending on the level of budget available and the degree to which cluster strategies serve as a way of integrating other policy measures as opposed to a stand-alone approach to regional development. Raines groups the resulting cluster policies into three categories: community building, linkages and joint projects, and development of common resources.

⁵ Philip Raines, Developing cluster policies in seven European regions. Glasgow: European Policies Research Centre, University of Strathclyde, RD42, December 2000.

Recommendations

1. Periodically convene cluster roundtables to assess conditions in each cluster, establish public policy and program agendas, and work jointly on implementation of those agendas. This may take the form of working with established cluster organizations, or assistance in creating such organizations where needed. Quarterly meetings are recommended to start with; participants may agree to meet more or less frequently depending on the agendas adopted.
2. Periodically assess development trends and prospects for major regional clusters. Annual or biennial reports should be prepared in consultation with relevant associations and industry leaders. These reports should be distributed to agencies, legislators, local economic development organizations, and interested members of the public to ensure a common base of understanding of the major challenges and opportunities faced by significant clusters throughout the state.
3. Systematically and regularly review state agency programs that affect economic viability of clusters to ensure that cluster needs are considered in allocating resources and establishing service priorities. Rather than meeting the needs of a single firm, priority should be given to projects that meet broad cluster competitiveness needs.
4. Review regulatory processes and establish mechanisms for enhanced coordination among state agencies, and MOUs or other methods of coordinating with local regulatory processes; develop mechanisms to encourage innovative solutions and encourage companies to reach beyond regulatory limits towards sustainable long term solutions.
5. Review and strengthen education and training programs that serve the needs of employers and workers in particular clusters. Oversight agencies such as the OSPI, SBCTC, HECB, and WTECB should develop mechanisms to ensure that information about cluster trends is available to inform decisions about program offerings, FTE allocations, and capital budgets. Develop policies to ensure that curricula meet current needs of employers and job seekers in major industry clusters.
6. Re-examine support for public research institutions and technology transfer processes. Support of research may have to take the form of allocations to capital budgets given budget constraints, but opportunities should be sought to match the research investments other states have made with tobacco settlement funds. While the current self-financing model of technology transfer is laudable from a budgetary perspective, it may be possible to stimulate growth in the technology transfer activity to a considerably higher but ultimately again self-financing level based on a more aggressive industry outreach and marketing effort.
7. Review criteria for CERB funding to ensure that cluster needs are considered in review of particular projects.
8. Consider launching a competitive RFP process to fund cluster projects at the local level that would be supported by state agencies in ways spelled out in the proposals. These projects could have many different purpose, including but not limited to:

- Building the identity and cohesion of a regional cluster,
- Marketing the competence of the cluster nationally and internationally,
- Implementing joint projects to open new markets or develop new technologies needed by the cluster,
- Bringing in new resources or competencies needed by the cluster and not locally available, and
- Upgrading incumbent worker skills or improving education programs aimed at bringing new workers into the cluster.

The ability to leverage state resources would be a factor in picking winning proposals as well as the quality of the idea, private sector support, local resource use, fit with the local and state economy including benefits to distressed regions and disadvantaged populations, and growth potential of the cluster. Potential bidders in such a process could include industry associations or broad multi-sector coalitions, Economic Development Councils/Districts/Boards, or groups of firms who establish a formal collaborative structure for the purpose of developing and implementing a cluster project.

APPENDIX

Data on Cluster Characteristics

Summary Data on Washington's Industry Clusters

	Metal-working	Electronics and Computers	Wood Products	Non-ferrous Metals	Aero-space	Aluminum	Concrete, Cement & Brick	Food Processing	Software	Biotech	Tourism	International Trade	Health Care
Employment 1990	42,342	25,913	30,101	6,880	117,615	9,951	3,216	48,683	14,935	9,221	213,077	45,561	168,983
Employment 2000	44,692	34,081	26,085	1,402	88,079	6,193	3,535	49,757	70,167	14,534	261,625	50,065	216,618
Percent Change	5.50%	31.50%	-13.30%	-79.6%	-25.10%	-37.80%	9.90%	2.20%	369.80%	57.60%	22.80%	9.90%	28.20%
Gross Business Income 1990	\$4,269B	\$2,755B	\$6,230B	\$0.322B	\$2.007B	\$2.617B	\$0.191B	\$5,752B	\$7.132B	\$1.241B	\$7.833B	\$3.454B	\$9.876B
Gross Business Income 2000	\$7,320B	\$3,726B	\$6,389B	\$0.162B	\$3.781B	\$1.865B	\$0.298B	\$7,591B	\$6.613B	\$2.040B	\$10.166B	\$3.777B	\$13.223B
Percent Change	66.4%	34.5%	2.6%	31.5%	88.7%	-28.7%	56.0%	32.0%	-7.3%	64.4%	29.8%	10.4%	33.9%
Location Coefficients													
King	0.5	0.8	0.8	0.1	12.2	0.6	0.6	1.3	4.0	3.0	0.9	0.8	0.6
North Puget Sound	0.5	1.7	1.7	0.2	29.5	0.4	0.6	0.8	0.6	1.3	0.8	0.3	0.6
South Puget Sound	0.4	0.4	2.2	0.3	1.6	1.6	0.6	0.7	0.5	0.7	0.8	0.6	0.8
Olympic Peninsula	0.3	0.1	6.2	0.2	0.8	2.3	1.1	1.2	0.3	0.6	1.1	0.4	0.8
Northwest	0.5	0.5	2.8	0.2	0.2	11.0	1.5	1.5	0.5	0.6	0.9	0.6	0.8
Central	0.4	0.2	2.3	0.8	0.7	10.0	1.0	2.2	0.1	0.5	0.8	0.6	0.7
Southeast	0.3	0.5	1.0	0.4	0.7	0.6	0.5	5.3	0.6	1.5	0.8	0.4	0.8
Northeast	0.7	1.1	2.1	0.1	1.8	5.5	1.8	1.7	0.5	0.6	0.9	0.6	1.1
Southwest	0.8	1.6	3.2	0.0	0.2	10.4	0.9	0.8	0.6	0.8	0.9	0.6	0.8
Washington	0.6	1.1	1.6	0.8	9.3	3.9	1.1	1.3	1.1	1.4	1.0	1.2	0.9

Note - printing and publishing, and business services were not included in the data exercise in the appendix

Tourism

Composition

Air transportation
Travel arrangements
Hotels and Motels
Recreational Vehicle Parks
Eating and Drinking Places
Commercial Sports

Institutions

Tourism Division, OTED
Visitor and Convention Bureaus

Employment

Establishments reporting employment - 1990	11,890
Establishments reporting employment - 2000	15,749
Change	3,859
% Change	32.5%

Employment - 1990	213,077
Employment - 2000	261,625
Change	48,548
% Change	22.8%

Revenue

Establishments reporting revenue- 1994	18,497
Establishments reporting revenue- 1999	16,580
Change	(1,917)
% Change	-11.6%

Gross Business Income – 1990 (Reportable to Washington State)	\$7.833 billion
Gross Business Income – 2000 (Reportable to Washington State)	\$10.166 billion
Change	\$2.332 billion
% Change	29.8%

Location Coefficients

King	0.900
North Puget Sound	0.834
South Puget Sound	0.825
Olympic Peninsula	1.107
Northwest	0.942
Central	0.834
Southeast	0.818
Northeast	0.850
Southwest	0.932
Washington	1.045

International Trade

Composition

Marine Ports
Airports
Railroads
Shipping Companies
Trucking
Misc. Transportation Services (packing, weighing, cargo surveyors)
Specialized Service Providers (brokers, insurance, law)

Institutions

Washington Council on International Trade
World Trade Club
Agricultural Commodity Commissions
IMPACT-WSU
CINTRAFOR-UW
International Organizations (e.g. WTO)

Employment

Establishments reporting employment - 1990	1,746
Establishments reporting employment- 2000	2,196
Change	450
% Change	25.8%
Employment – 1990	45,561
Employment – 2000	50,065
Change	4,504
% Change	9.9%

Revenue	
Establishments reporting revenue- 1994	1,803
Establishments reporting revenue- 1999	1,501
Change	(302)
% Change	-20.1%
Gross Business Income - 1990 (Reportable to Washington State)	\$3.454 billion
Gross Business Income - 2000 (Reportable to Washington State)	\$3.777 billion
Change	\$0.332 billion
% Change	10.4%

Location Coefficients	
King	0.801
North Puget Sound	0.303
South Puget Sound	0.614
Olympic Peninsula	0.412
Northwest	0.551
Central	0.593
Southeast	0.352
Northeast	0.573
Southwest	0.609
Washington	1.162

Note: multiple establishment-reporting problems for transportation companies with establishments in more than one county, resulting in a statewide l.q. higher than any regional l.q.

Health Care

Composition	
Offices and Clinics of Doctors of Medicine	
Offices and Clinics of Dentists	
Offices and Clinics of Doctors of Osteopathy	
Offices and Clinics of Other Health Practitioners	
Nursing and Personal Care Facilities	
Hospitals	
Medical and Dental Laboratories	
Home Health Services	
Misc. Health and Allied Services NEC	

Institutions	
UW Medical School	
Association of Washington Hospitals	
American Medical Association	

Employment

Establishments reporting employment - 1990	5,307
Establishments reporting employment- 2000	6,864
Change	1,557
% Change	29.3%

Employment – 1990	168,983
Employment – 2000	216,618
Change	47,635
% Change	28.2%

Revenue

Establishments reporting revenue - 1994	15,323
Establishments reporting revenue - 1999	12,836
Change	(2,487)
% Change	-19.4%

Gross Business Income - 1990 (Reportable to Washington State)	\$9.876 billion
Gross Business Income - 2000 (Reportable to Washington State)	\$13.223 billion
Change	\$3.347 billion
% Change	33.9%

Location Coefficients

King	0.607
North Puget Sound	0.634
South Puget Sound	0.815
Olympic Peninsula	0.783
Northwest	0.773
Central	0.689
Southeast	0.786
Northeast	1.070
Southwest	0.792
Washington	0.910

Metalworking

Composition

Primary Smelting and Refining
Metal Fabrication and Assembly Sectors

Institutions

None

Employment

Establishments reporting employment - 1990	1,315
Establishments reporting employment - 2000	1,714
Change	399
% Change	30.3%
Employment - 1990	42,342
Employment – 2000	44,692
Change	2,350
% Change	5.5%

Revenue

Establishments reporting revenue - 1994	1,937
Establishments reporting revenue - 1999	1,784
Change	(153)
% Change	-8.6%
Gross Business Income - 1990 (Reportable to Washington State)	4,269,845,540
Gross Business Income - 2000 (Reportable to Washington State)	7,320,464,077
Change	2,834,927,245
% Change	66.4%

Location Coefficients

King	0.476
North Puget Sound	0.495
South Puget Sound	0.377
Olympic Peninsula	0.307
Northwest	0.545
Central	0.367
Southeast	0.328
Northeast	0.738
Southwest	0.779
Washington	0.639

Electronics and Computers

Composition

Electronic computers & components
Electrical machinery & components
Instruments of All Types
Communications Equipment
Search and Navigation Equipment
Plating and Polishing
Laboratory Apparatus
Nonferrous Wire Drawing & Insulating
Magnetic & Optical Recording Media
Office Machines

Institutions

AeA Washington Chapter
(formerly the American Electronics Association Washington Chapter)
Technology Alliance

Employment

Establishments reporting employment - 1990	395
Establishments reporting employment - 2000	531
Change	136
% Change	34.4%
Employment - 1990	25,913
Employment - 2000	34,081
Change	8,169
% Change	31.5%

Revenue

Establishments reporting revenue – 1994	382
Establishments reporting revenue – 1999	382
Change	-
% Change	0.0%
Gross Business Income – 1990 (Reportable to Washington State)	2,755,223,401
Gross Business Income – 2000 (Reportable to Washington State)	3,726,268,133
Change	951,706,600
% Change	34.5%

Location Coefficients	
King	0.757
North Puget Sound	1.744
South Puget Sound	0.426
Olympic Peninsula	0.131
Northwest	0.471
Central	0.186
Southeast	0.465
Northeast	1.119
Southwest	1.560
Washington	1.060

Food Processing

Composition	
Packaged Foods (e.g., cookies, crackers, cereals, flours, pasta, roasted coffee)	
Canned & Bottled Goods	
Dairy Products	
Meat Products	

Institutions	
Northwest Food Processing Association	

Employment	
Establishments reporting employment - 1990	2994
Establishments reporting employment- 2000	3022
Change	28
% Change	0.9%
Employment - 1990	48683
Employment - 2000	49757
Change	1074
% Change	2.2%

Revenue	
Establishments reporting revenue- 1994	283
Establishments reporting revenue- 1999	395
Change	20
% Change	4.2%
Gross Business Income – 1990 (Reportable to Washington State)	5,752,962,299
Gross Business Income - 2000 (Reportable to Washington State)	7,591,593,727
Change	1,838,631,428
% Change	32.0%

Location Coefficients

King	1.258
North Puget Sound	0.827
South Puget Sound	0.724
Olympic Peninsula	1.227
Northwest	1.540
Central	2.232
Southeast	5.288
Northeast	1.745
Southwest	0.835
Washington	1.316

Wood products

Composition

Logging
Sawmills and Planing Mills
Millwork, Veneer, Plywood, and Structural Wood
Members
Wood Containers
Wood Buildings and Mobile Homes
Misc. Wood Products

Institutions

APA Engineered Wood Association
CINTRAFOR
Evergreen Building Products Association
Western Wood Products Association

Employment

Establishments reporting employment - 1990	802
Establishments reporting employment - 2000	733
Change	(69)
% Change	-8.6%
Employment – 1990	30,101
Employment – 2000	26,085
Change	(4,017)
% Change	-13.3%

Revenue	
Establishments reporting revenue - 1994	1,647
Establishments reporting revenue - 1999	1,407
Change	(240)
% Change	-17.1%
Gross Business Income - 1990 (Reportable to Washington State)	6,230,672,132
Gross Business Income - 2000 (Reportable to Washington State)	6,389,204,809
Change	161,320,375
% Change	2.6%

Location Coefficients	
King	0.794
North Puget Sound	1.696
South Puget Sound	2.213
Olympic Peninsula	6.200
Northwest	2.818
Central	2.310
Southeast	0.962
Northeast	2.097
Southwest	3.224
Washington	1.639

Nonferrous Metals

Composition
Smelting and Refining of Non-Ferrous Metals
Fabrication of Non-Ferrous Metal Products (e.g., valves, jewelry)

Institutions
None

Employment	
Establishments reporting employment - 1990	80
Establishments reporting employment - 2000	71
Change	(9)
% Change	-11.3%
Employment – 1990	6,880
Employment – 2000	1,402
Change	(5,478)
% Change	-79.6%

Revenue

Establishments reporting revenue - 1994	90
Establishments reporting revenue - 1999	75
Change	(15)
% Change	-20.0%

Gross Business Income - 1990 (Reportable to Washington State)	322,912,919
Gross Business Income - 2000 (Reportable to Washington State)	162,198,385
Change	101,659,444
% Change	31.5%

Location Coefficients

King	0.136
North Puget Sound	0.187
South Puget Sound	0.305
Olympic Peninsula	0.187
Northwest	0.196
Central	0.831
Southeast	0.395
Northeast	0.107
Southwest	0.041
Washington	0.840

Aerospace

Composition

Rolling, Drawing, and Extruding of Nonferrous Metals (aluminum)
Aircraft and Parts
Guided Missile and Space Vehicles and Parts

Institutions

Washington Aerospace Alliance
International Association of Machinists
Society of Professional Engineering Employees

Employment

Establishments reporting employment - 1990	237
Establishments reporting employment - 2000	222
Change	(15)
% Change	-6.3%

Employment – 1990	117,615
Employment – 2000	88,079
Change	(29,536)
% Change	-25.1%

Revenue

Establishments reporting revenue - 1994	108
Establishments reporting revenue - 1999	119
Change	11
% Change	9.2%

Gross Business Income - 1990 (Reportable to Washington State)	20,078,955,484
Gross Business Income - 2000 (Reportable to Washington State)	37,818,629,747
Change	17,804,807,086
% Change	88.7%

Location Coefficients

King	12.159
North Puget Sound	29.500
South Puget Sound	1.551
Olympic Peninsula	0.823
Northwest	0.166
Central	0.703
Southeast	0.658
Northeast	1.781
Southwest	0.197
Washington	9.336

Aluminum

Composition

Primary Aluminum Smelting and Refining
Metal Foil & Leaf
Secondary Nonferrous Metals
Draper Hardware

Institutions

Direct Service Industries, Inc.

Employment

Establishments reporting employment - 1990	26
Establishments reporting employment- 2000	35
Change	9
% Change	34.6%
Employment - 1990	9,951
Employment - 2000	6,193
Change	(3,758)
% Change	-37.8%

Revenue

Establishments reporting revenue - 1994	26
Establishments reporting revenue - 1999	26
Change	-
% Change	0.0%
Gross Business Income - 1990 (Reportable to Washington State)	2,617,613,919
Gross Business Income - 2000 (Reportable to Washington State)	1,865,162,985
Change	(752,450,934)
% Change	-28.7%

Location Coefficients

King	0.623
North Puget Sound	0.417
South Puget Sound	1.609
Olympic Peninsula	2.347
Northwest	11.015
Central	10.027
Southeast	0.589
Northeast	5.452
Southwest	10.375
Washington	3.885

Concrete, Cement, and Brick

Composition

Cement
Concrete, Gypsum and Plaster Products

Institutions

None

Employment

Establishments reporting employment - 1990	112
Establishments reporting employment - 2000	114
Change	2
% Change	1.8%

Employment - 1990	3,216
Employment - 2000	3,535
Change	320
% Change	9.9%

Revenue

Establishments reporting revenue - 1994	41
Establishments reporting revenue - 1999	37
Change	(4)
% Change	-10.8%

Gross Business Income - 1990 (Reportable to Washington State)	191,099,488
Gross Business Income - 2000 (Reportable to Washington State)	298,163,056
Change	107,063,568
% Change	56.0%

Location Coefficients

King	0.648
North Puget Sound	0.604
South Puget Sound	0.580
Olympic Peninsula	1.077
Northwest	1.528
Central	1.008
Southeast	0.532
Northeast	1.788
Southwest	0.943
Washington	1.117

Software/Data Processing Services/Internet

Composition

Computer Programming Services
Prepackaged Software
Computer Integrated Systems Design
Computer Processing and Data Preparation and Processing Services
Information Retrieval Services
Computer Related Services NEC
(includes consultants, data base developers, requirements analysts)

Institutions

WSA
(formerly the Washington Software Alliance)
Society for Information Management
Artificial Intelligence Society
Puget Sound Computer User Group
Technology Alliance

Employment

Establishments reporting employment - 1990	890
Establishments reporting employment - 2000	4,012
Change	3,122
% Change	350.8%

Employment - 1990	14,935
Employment - 2000	70,167
Change	55,232
% Change	369.8%

Revenue

Establishments reporting revenue - 1994	4,974
Establishments reporting revenue - 1999	5,722
Change	748
% Change	13.1%

Gross Business Income - 1990 (Reportable to Washington State)	7,132,155,186
Gross Business Income - 2000 (Reportable to Washington State)	6,613,215,449
Change	(518,939,737)
% Change	-7.3%

Location Coefficients

King	3.983
North Puget Sound	0.588
South Puget Sound	0.458
Olympic Peninsula	0.312
Northwest	0.469
Central	0.132
Southeast	0.580
Northeast	0.505
Southwest	0.585
Washington	1.070

Biotechnology

Composition

Commercial Physical and Biological Research
(many for-profit biotechnology companies are classified in this category)
Non-Commercial Research Organizations
(including Fred Hutchinson Cancer Research Center)
Pharmaceutical Manufacturing
Venture Capitalists

Institutions

University of Washington School of Medicine
Washington Biotechnology and Biomedical
Association
Washington Biotechnology Research Foundation
Seattle Cancer Care Alliance
Technology Alliance

Employment

Establishments reporting employment - 1990	235
Establishments reporting employment - 2000	534
Change	299
% Change	127.2%

Employment - 1990	9,221
Employment - 2000	14,534
Change	5,313
% Change	57.6%

Revenue

Establishments reporting revenue - 1994	362
Establishments reporting revenue - 1999	329
Change	(33)
% Change	-10.0%

Gross Business Income – 1990 (Reportable to Washington State)	1,241,746,510
Gross Business Income – 2000 (Reportable to Washington State)	2,040,820,890
Change	799,074,380
% Change	64.4%

Location Coefficients	
King	3.041
North Puget Sound	1.347
South Puget Sound	0.729
Olympic Peninsula	0.579
Northwest	0.612
Central	0.521
Southeast	1.470
Northeast	0.557
Southwest	0.793
Washington	1.391